Supporting Information

Prussian blue analogue (PBA) derived Cobalt Telluride Nanogranules: An efficient catalyst for energy conversion and storage

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Electrochemical calculations:

The intrinsic electrocatalytic activity of all the electrocatalysts were determined by iR compensating the recorded polarization plots as per the following equation,

$$E_{iR\ corrected} = E_{observed} - iR \text{ ....} \quad (1)$$

Here, i and R are the observed anodic current and solution resistance (R_s) of the electrocatalyst. The R_s was obtained from the Nyquist impedance spectrum recorded in the frequency range of 1 MHz to 0.1 Hz at an applied amplitude of 5 mV.

(a) Determination of Electrochemical active surface area (ECSA)

The electrochemical active surface area has been evaluated by measuring the double layer capacitance (C_{dl}) of $Co_{0.63}Te$, Co-PBA, $Co_{0.63}Te$ and RuO_2. For this, CVs are collected in a non-Faradaic region (1.24-1.26 V vs. Hg/HgO) at different scan rates (20, 40, 80, 100, 200 mV/s). The ECSA has a linear relation with double layer capacitance (C_{dl}). ECSA was determined from the C_{dl} values by adopting following equation,[1]

$$ECSA = \frac{C_{dl}}{C_s} \text{ ....} \quad (2)$$

(b) Calculation of specific capacitance, energy density and power density

The specific capacitance (C_s) of $Co_{0.63}Te$ has been calculated from both the cyclic voltammogram (equation 4) and galvanostatic charge-discharge profiles (equation 3) as per the following equations,[2]

$$C_s = \frac{\int_{V_a}^{V_c} I(V)dV}{m\vartheta\ (\Delta V)} \text{...} \quad (3)$$

Here, the $\int_{V_a}^{V_c} I(V)dV, m, \vartheta, (\Delta V)$ are the integrated area of the CV curve, mass of the electrode material, scan rate and the optimized potential window taken for the measurement. Thereafter the energy density (ED) and power density (PD) was calculated from the Cs values as per the following,[3]

$$ED = \frac{C_s(\Delta V)^2}{2} \text{...} \quad (4)$$

$$PD = \frac{C_s(\Delta V)\vartheta}{2} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (5)$$

(c) Calculation of capacitive contribution

At first the CVs of $Co_{0.63}Te$ modified electrode from 5 to 100 mV/s scan rate has been recorded. Thereafter the degree of capacitive effect has been calculated from the relation among the observed current (i) and scan rate (v) from the CV curves as per the following equation,[4,5]

$$i = av^b \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (6)$$

Here both the "a" and "b" are the constants and the value of "b" varies from 0.5 to 1.0 that calculated from the slope of the plot of *log i* vs. *log v* (Fig. 5c).

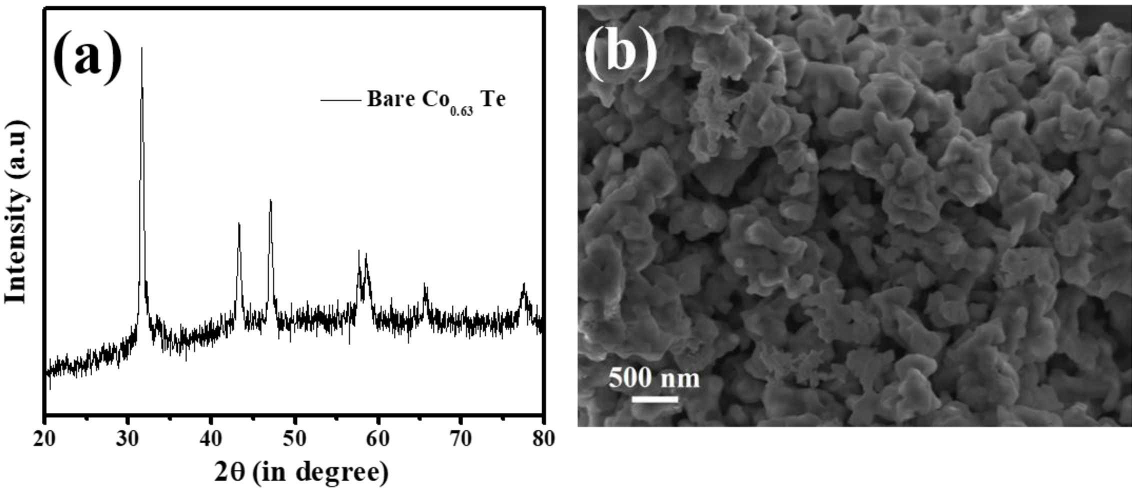

Figure S 1. PXRD (a), FESEM (b) of bare $Co_{0.63}Te$.

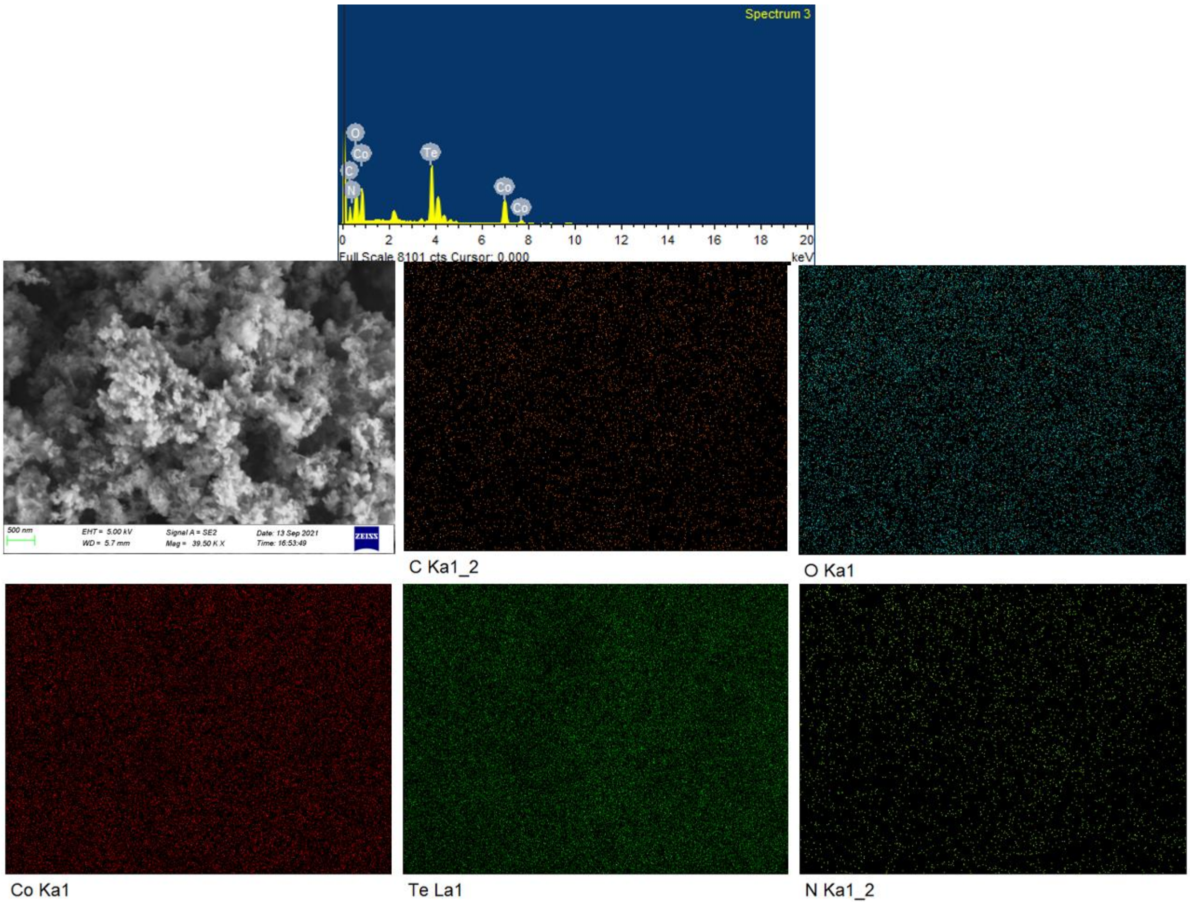

Figure S 2. EDS spectrum and elemental mapping of elements in $Co_{0.63}Te$.

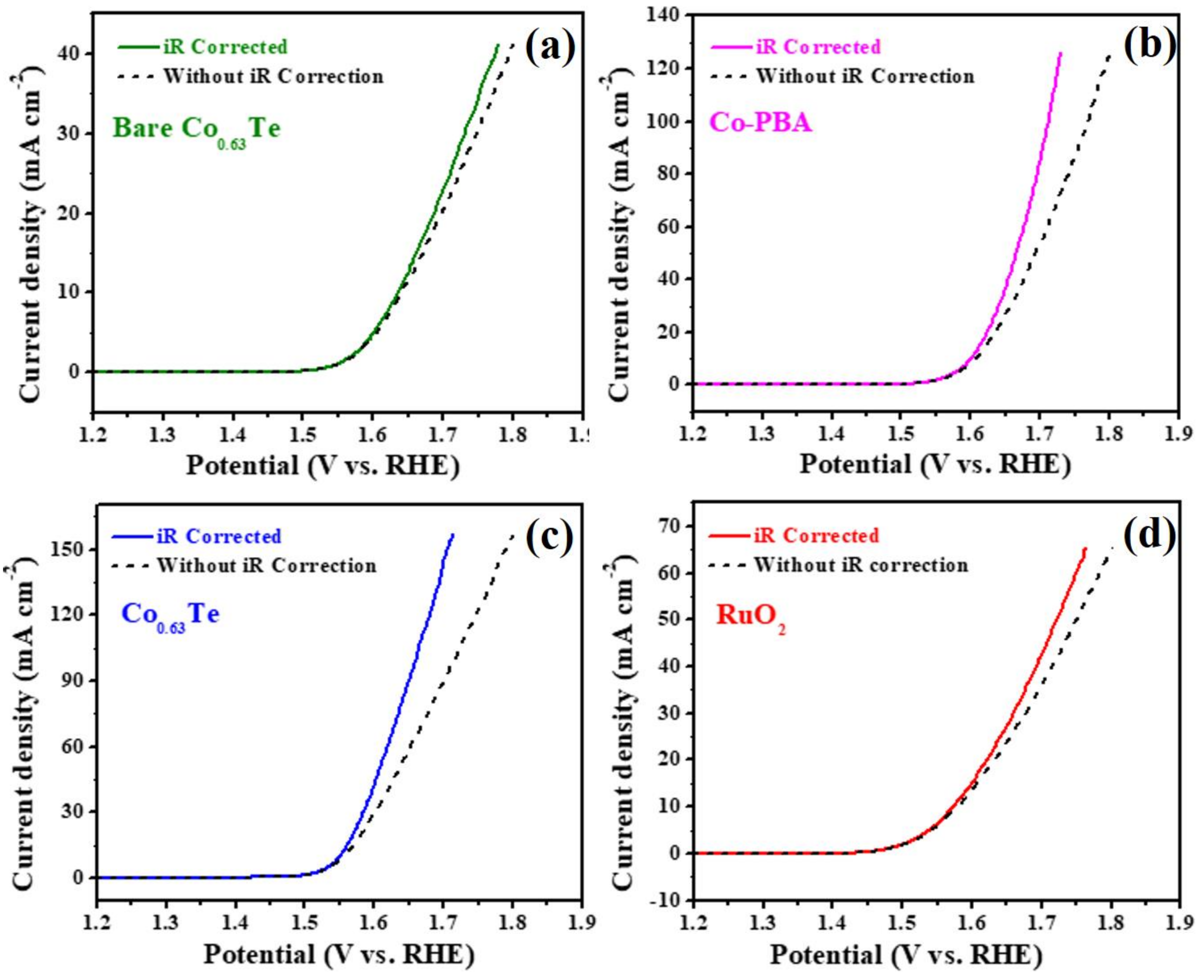

Figure S 3. OER LSV polarization curve for (a) $Co_{0.63}Te$, (b) Co-PBA, (c) bare $Co_{0.63}Te$ and (d) RuO_2 modified electrodes in 1 M KOH electrolyte at scan rate of 5 mV/s with and without iR compensation.

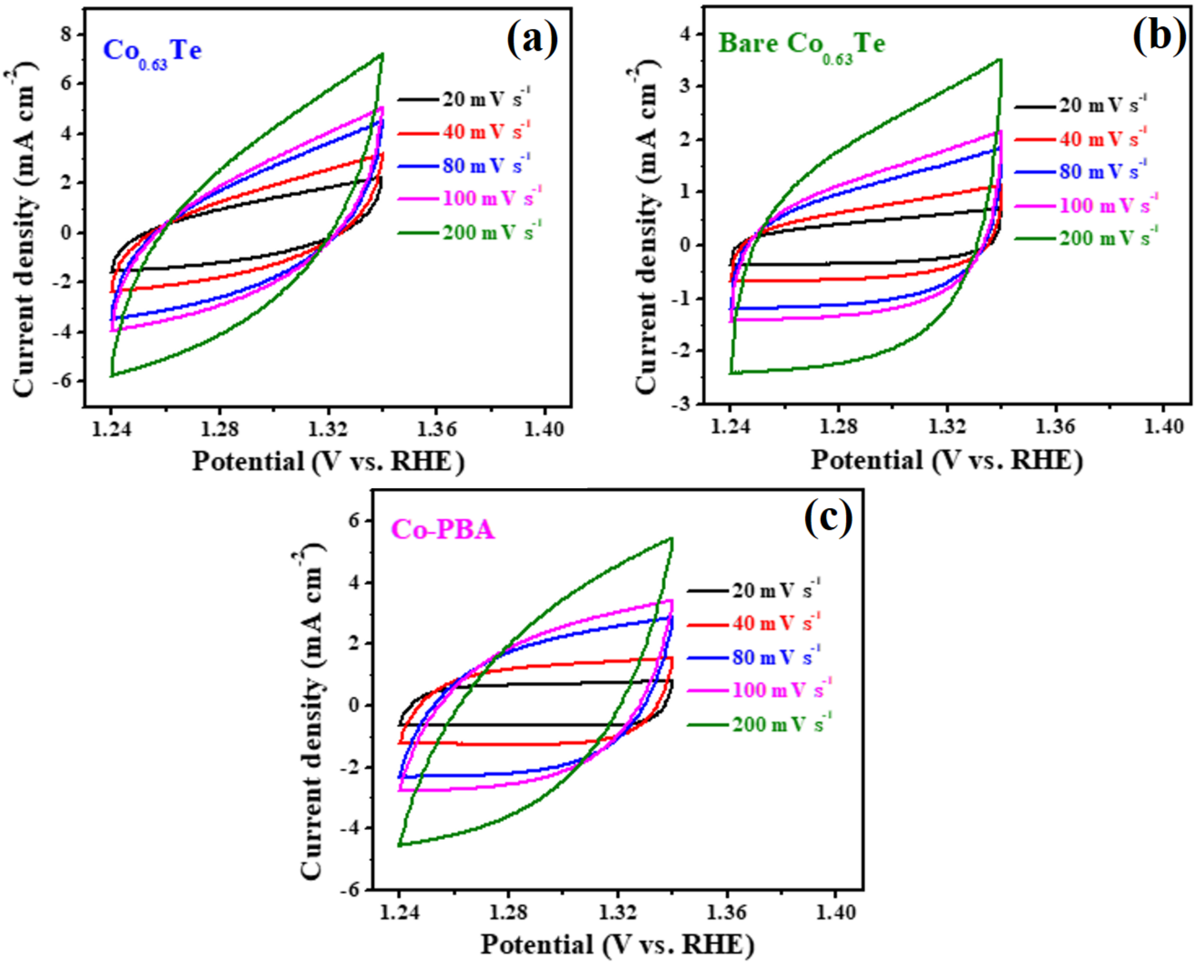

Figure S 4. CVs for (a) $Co_{0.63}Te$, (b) bare $Co_{0.63}Te$, (c) Co-PBA showing in a non-Faradaic region at a scan rate of 20, 40, 80, 100, 200 mV/s respectively.

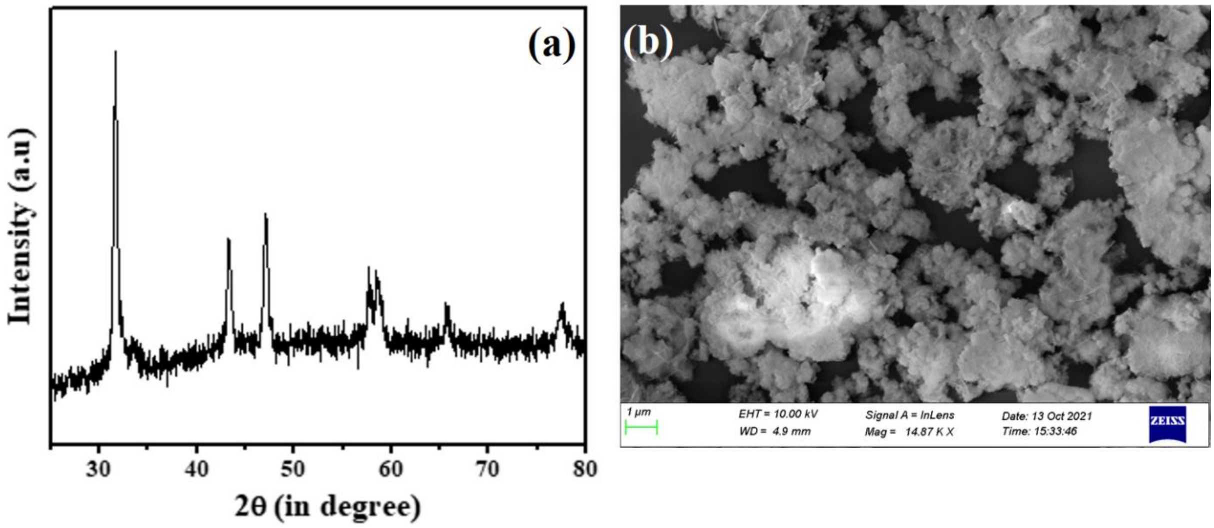

Figure S 5. Powder X-ray pattern (a), FESEM image of $Co_{0.63}Te$ after OER.

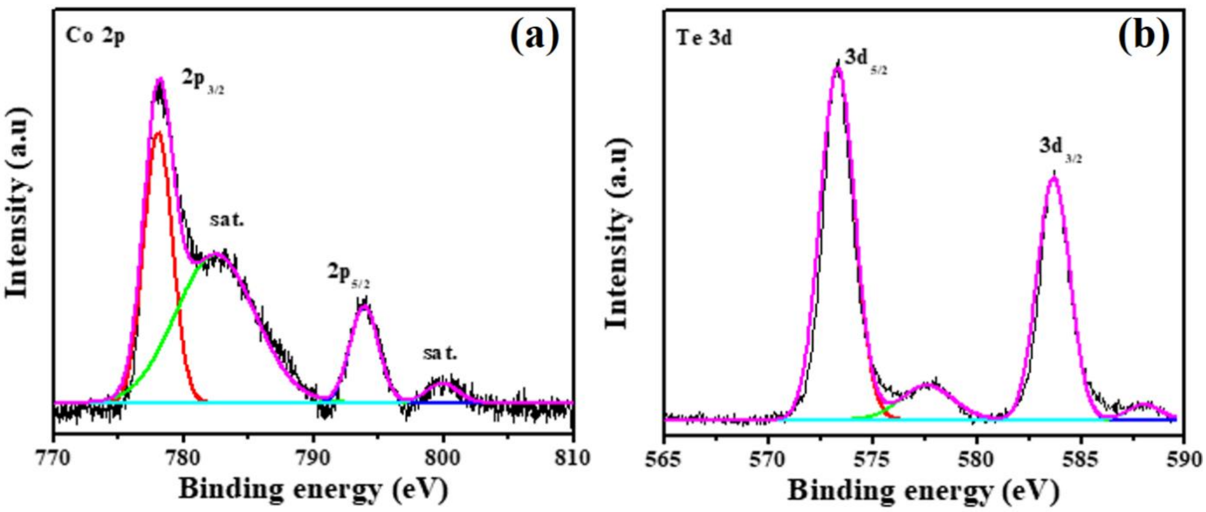

Figure S 6. XPS spectrum of (a) Co 2p (b) Te 3d in $Co_{0.63}Te$ after OER.

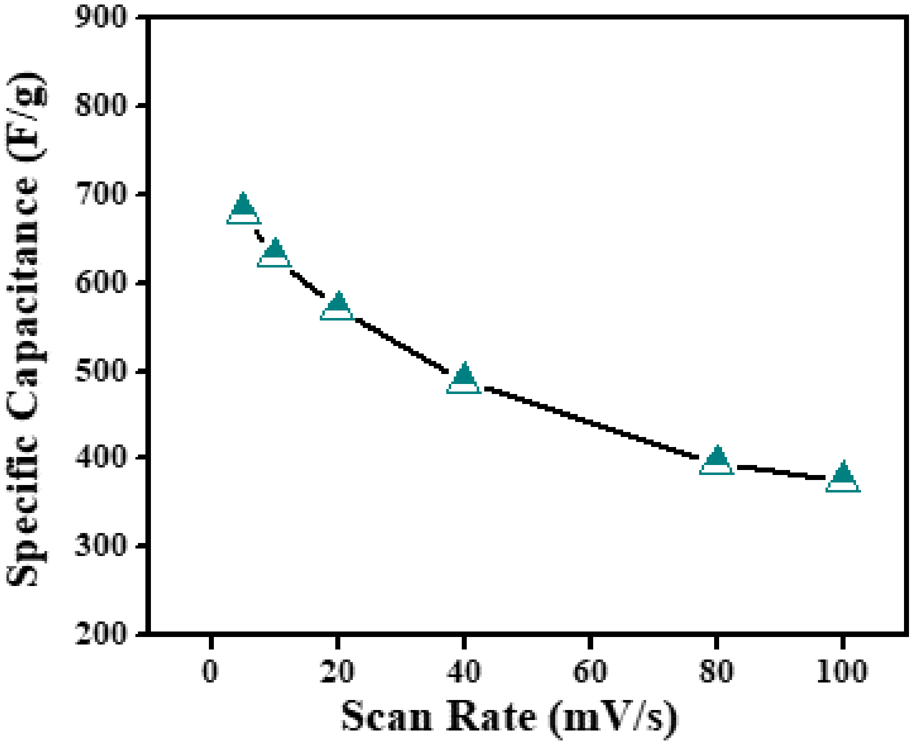

Figure S 7. Variation of specific capacitance with scan rate of $Co_{0.63}Te$.

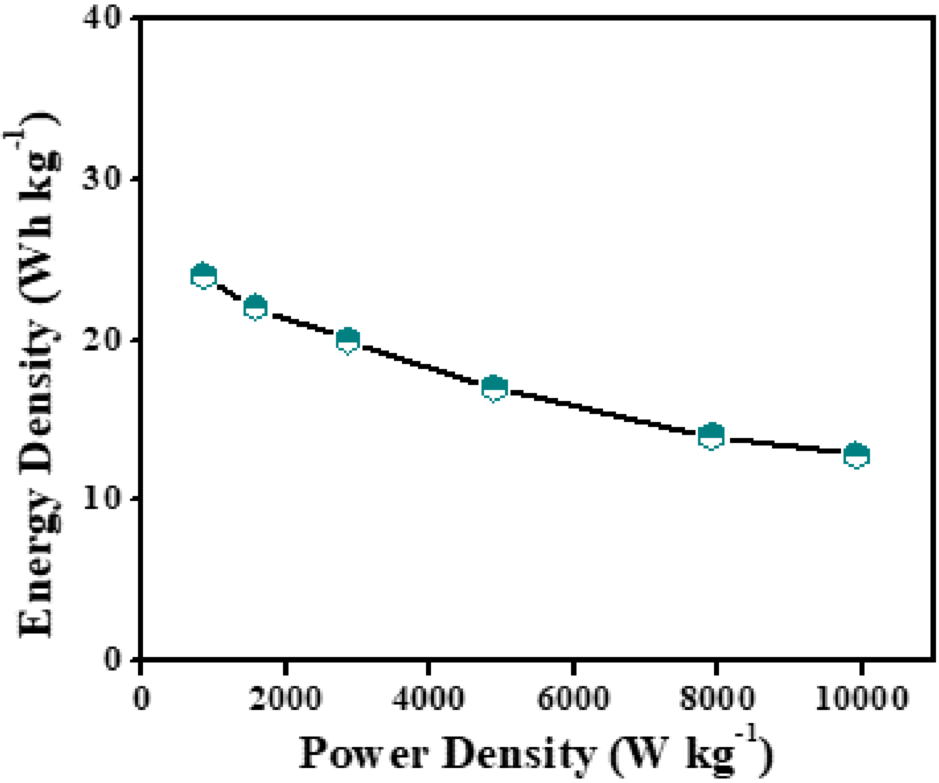

Figure S 8. Ragone plot of $Co_{0.63}Te$.

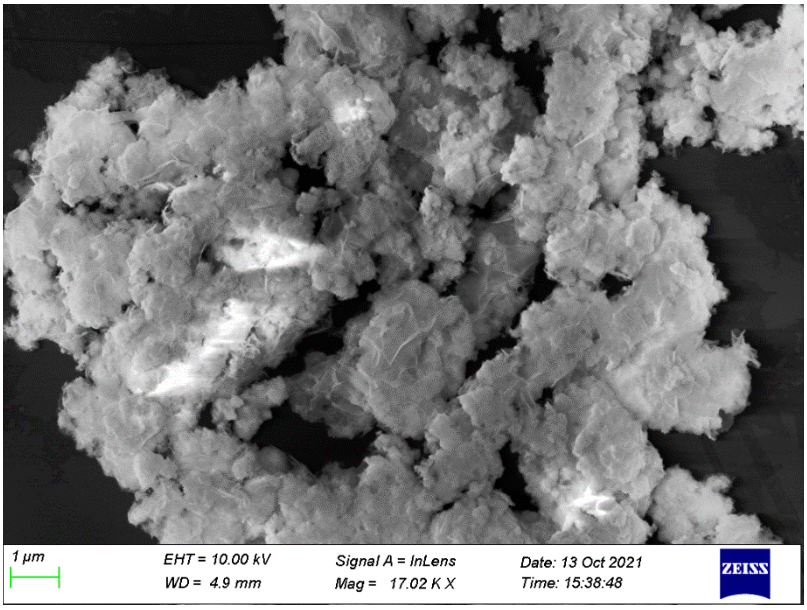

Figure S 9. FESEM image of $Co_{0.63}Te$ after 5000 CV cycles.

Table S1. Comparison of various cobalt telluride for oxygen evolution reaction.

Catalysts	Electrolyte (Conc)	Overpotential (mV)	Tafel slope (mV/decade)	References
CoTe-Ni foam	1 M KOH	241	66	Fuel, 280, 2020, 118666
Co@$CoTe_2$	1 M KOH	286	42	Inorg. Chem. Front., 2020,7, 2523-2532
$CoTe_2$@NCNTFs	1 M KOH	330	82.8	J. Mater. Chem. A, 2018, 6, 3684
CoTe	1 M KOH	200	43.8	ACS Appl. Energy Mater. 2021, 4, 8158−8174
$CoTe_2$/CNT/GCE	1 M KOH	290	44.2	J. Phys. Chem. C 2016, 120, 28093−28099
$CoTe_2$/GCE	1 M KOH	380	58.0	ACS Catal., 2016, 6, 7393-7397.
$CoTe_2$/CNT/GCE	0.1 M KOH	357	32.0	Angew. Chem. Int. Ed. 2017, 56, 7769 –7773
CoTe	1 M KOH	445	93.1	Electrochimica Acta 321 (2019) 134656
$CoTe_2$ @ NF	1 M KOH	340	54.0	Electrochim. Acta., 2019, 307, 451-458.
CoTe/NR/NF	1 M KOH	350	75.0	Small Methods, 2019, 3, 1900113.
$Co(Te_{0.72}Se_{0.28})_2$	1 M KOH	315	69.0	Nanoscale, 2019, 11, 6108-6119.
$Co_{0.63}Te$	**1 M KOH**	**319**	**56**	**Our Work**

Table S2. Comparison of various cobalt chalcogenides for supercapacitor application.

Catalysts	**Electrolyte (Conc)**	**Specific Capacitance (F/g)**	**References**
$CoTe_2$	----	460	Ceram. Int. **2020**, *46* (5), 6991–6994
$NiCo_2S_4$ nanoplate	3 M KOH	437	ACS Sustainable Chem. Eng. 2014, 2, 4, 809–815
PCs/$NiCo_2S_4$	6 M KOH	605.2	Applied surface science, 2019, 463, 1001-1010
NCS/graphene	3 M KOH	710	ACS Appl. Energy Mater. 2021, 4, 8262-8274
$CoSe_2$	6 M KOH	333	J. Mater. Chem. C, 2021, 9, 228
$NiSe_2$	2 M KOH	341	J. Mater. Chem. A, 2017, 5, 3621
$Co_{0.63}Te$	**5 M KOH**	**680**	**Our Work**

Table S3. Comparison of electrochemical parameters of some similar reported literature.

Sl. No	Catalyst	Electrolyte	Overpotential (η) (mV)	Tafel slope (mV/decade)	Remarks	References
1	ED-CoTe, ED-$CoTe_2$, HD-CoTe, HD-$CoTe_2$	1 M KOH	200, 240, 270, 320@10 mA/cm^{-2}	43.8, 44.8, 67.7, 111.8	Electro deposition (ED), Hydrothermal (HD) route used on Au glass and carbon cloth respectively.	ACS Appl. Energy Mater. 2021, 4, 8158−8174
2	NC-PB@ CNT	1 M KOH	240@10 mA/cm^{-2}	73	CNT incorporated Ni-Co-PBA on Ni foam.	Chemical Engineering Journal 426 (2021) 130773
3	Co-Fe PBA	1 M KOH	256@10 mA/cm^{-2}	54	Nickel foam used as substrate by hydrothermal route.	Nanoenergy,2019,
4	Co/CoTe heterostructure	1 M KOH	400@50mA/cm^{-2}	94.1	Solvothermal followed by high temperature heating.	Applied Surface Science, 581, 2022, 152405
5	$Co_{0.63}Te$ (Present work)	1 M KOH	317@ 10 mA/cm^{-2}	56	Facile solvothermal approach. Catalyst coated on GCE.	Our Work

References

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